CLAIMS

What is claimed is:

1. A method for transmitting a downlink signal in a substantially non directional manner from a communication station to a first remote communication device on a downlink channel, the communication station including a smart antenna system having an array of antenna elements, the method comprising:

determining a first downlink smart antenna processing strategy for transmitting in a first non-directional manner;

transmitting a first downlink message from the communication station in the first non-directional manner using the first downlink smart antenna processing strategy; and

repeating transmitting the first downlink message from the communication station in a second non-directional manner,

wherein the repeated transmitting is non-identical repetition to facilitate the interference environment being different in the repetition.

2. A method as describe in claim 1, wherein the first substantially non-directional manner differs from the second substantially non-directional manner.

3. A method as describe in claim 1, further comprising:

determining at the communication station whether or not the first remote communication device successfully received the first transmitted first downlink message,

wherein the repeated transmitting is if the first remote communication device did not successfully receive the first transmitted first downlink message.

4. A method as describe in claim 1, further comprising:

receiving one or more signals at the communication station from one or more other remote communication devices known to the communication station to be undesired in that any other remote communication device might receive one or more signals during, and on the same downlink channel as, the transmitting of the first downlink message and the repeated transmitting of the first downlink message,

wherein the determining of the first and second downlink processing strategies use the signals received from the other remote communication device.

5. A method as described in claim 4,

wherein the communication station is a first base station of a communication system and the first remote communication device is a remote user terminal associated with the first base station, and

wherein each other remote communication device is a remote user terminal associated with one or more other base stations distinct from the first base station.

6. A method as described in claim 1, wherein the first communication station is able to communicate with the first remote communication device on a conventional TDMA channel.

7. A method as described in claim 1, wherein the first communication station is able to communicate with the first remote communication device on a conventional CDMA channel.

8. A method as described in claim 1, wherein the first communication station is able to communicate with the first remote communication device on a conventional FDMA channel.

9. A method as described in claim 1, wherein the first communication station comprises a cellular base station.

10. A method as described in claim 1, wherein the first remote communication device includes a second plurality of antenna elements.

11. A method as described in claim 10, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

12. A method as described in claim 1, wherein the communication station is coupled to an external data and/or voice network.

13. A method as described in claim 12, wherein the external network includes the Internet.

14. A method as described in claim 1, wherein the first remote communication device includes a first remote user terminal.

15. A method as described in claim 14, wherein the first remote user terminal is mobile.

16. A method as described in claim 4, wherein the steps of transmitting in the first and second non-directional manners include mitigating interference towards the undesired communication devices.

17. A method as described in claim 4,

wherein the first smart antenna processing strategy is for transmission in a first direction wherefrom there were no substantial signals received at the communication station in the receiving step,

wherein the second smart antenna processing strategy is for transmission in a second direction wherefrom there were no substantial signals received at the communication station in the receiving step, and

wherein the first and the second directions differ.

18. A method as described in claim 17, wherein the first and second smart antenna processing strategies are determined from the received signal covariance of the signals received at the communication station in the receiving step.

19. A communication station comprising:

a smart antenna system to communicate with a first remote communication device according to a smart antenna processing strategy, the smart antenna system including a plurality of antenna elements;

a processor to determine a first downlink smart antenna processing strategy;

a downlink transmission unit, coupled to the antenna element plurality and to the processor, to transmit a first downlink message from the communication station in the first non-directional manner using the first downlink smart antenna processing strategy;

the downlink transmission unit further to repeatedly transmit the first downlink message from the communication station in a second non-directional manner, the repeated transmitting being non-identical repetition to facilitate the interference environment being different in the repetition.

20. A communication station as describe in claim 19, wherein the first substantially non-directional manner differs from the second substantially non-directional manner.

21. A communication station as describe in claim 19, further comprising:

an uplink reception unit, coupled to the antenna element plurality, to receive an uplink response signal from the first remote communication device in response to the first downlink message, and

wherein the downlink transmission unit repeats transmitting the first downlink message if the first remote communication device did not successfully receive the first transmitted first downlink message.

22. A communication station as describe in claim 19, further comprising:

an uplink reception unit, coupled to the antenna element plurality and to the processor, to receive one or more signals from one or more other remote communication devices known to the communication station to be undesired in that any other remote communication device might receive one or more signals during, and on the same downlink channel as, the transmitting of the first downlink message and the repeated transmitting of the first downlink message,

wherein the processor further is to determine a second downlink smart antenna processing strategy, and wherein the processor determines the first and second downlink strategies using the signals received from the other remote communication device.

23. A communication station as described in claim 22,

wherein the communication station is a first base station of a communication system and the first remote communication device is a remote user terminal associated with the first base station, and

wherein each other remote communication device is a remote user terminal associated with one or more other base stations distinct from the first base station.

24. A communication station as described in claim 19, able to communicate with the first remote communication device on a conventional TDMA channel.

25. A communication station as described in claim 19, able to communicate with the first remote communication device on a conventional CDMA channel.

26. A communication station as described in claim 19, able to communicate with the first remote communication device on a conventional FDMA channel.

27. A communication station as described in claim 19, comprising a cellular base station.

28. A communication station as described in claim 19, wherein the first remote communication device includes a second plurality of antenna elements.

29. A communication station as described in claim 28, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

30. A communication station as described in claim 19, coupled to an external data and/or voice network.

31. A communication station as described in claim 30, wherein the external network includes the Internet.

32. A communication station as described in claim 19, wherein the first remote communication device includes a first remote user terminal.

33. A communication station as described in claim 32, wherein the first remote user terminal is mobile.

34. A communication station as described in claim 22, wherein first and second non-directional manners include mitigating interference towards the undesired communication devices.

35. A communication station as described in claim 22,

wherein the first smart antenna processing strategy is for transmission in a first direction wherefrom there were no substantial signals received at the communication station in the receiving step,

wherein the second smart antenna processing strategy is for transmission in a second direction wherefrom there were no substantial signals received at the communication station in the receiving step, and

wherein the first and the second directions differ.

36. A communication station as described in claim 35, wherein the first and second smart antenna processing strategies are determined from the received signal covariance of the signals received at the communication station in the receiving step.

37. A machine-readable medium having stored thereon information representing a set of machine-executable instructions, that, when executed by a machine, cause the machine to perform a method for transmitting a downlink signal in a substantially non directional manner from a communication station to a first remote communication device on a downlink channel, the communication station including a smart antenna system having an array of antenna elements, the method comprising:

determining a first downlink smart antenna processing strategy for transmitting in a first non-directional manner;

transmitting a first downlink message from the communication station in the first non-directional manner using the first downlink smart antenna processing strategy; and

repeating transmitting the first downlink message from the communication station in a second non-directional manner,

wherein the repeated transmitting is non-identical repetition to facilitate the interference environment being different in the repetition.

38. A machine-readable medium as described in claim 37, wherein the first substantially non-directional manner differs from the second substantially non-directional manner.

39. A machine-readable medium as described in claim 37,

wherein the method further includes:

determining at the communication station whether or not the first remote communication device successfully received the first transmitted first downlink message, and

wherein the repeated transmitting is if the first remote communication device did not successfully receive the first transmitted first downlink message.

40. A machine-readable medium as described in claim 37,

wherein the method further includes:

receiving one or more signals at the communication station from one or more other remote communication devices known to the communication station to be undesired in that any other remote communication device might receive one or more signals during, and on the same downlink channel as, the transmitting of the first downlink message and the repeated transmitting of the first downlink message, and

wherein the determining of the first and second downlink processing strategies use the signals received from the other remote communication device.

41. A machine-readable medium as described in claim 40,

wherein the communication station is a first base station of a communication system and the first remote communication device is a remote user terminal associated with the first base station, and

wherein each other remote communication device is a remote user terminal associated with one or more other base stations distinct from the first base station.

42. A machine-readable medium as described in claim 37, wherein the communication station is able to communicate with the first remote communication device on a conventional TDMA channel.

43. A machine-readable medium as described in claim 37, wherein the communication station is able to communicate with the first remote communication device on a conventional CDMA channel.

44. A machine-readable medium as described in claim 37, wherein the communication station is able to communicate with the first remote communication device on a conventional FDMA channel.

45. A machine-readable medium as described in claim 37, wherein the communication station comprises a cellular base station.

46. A machine-readable medium as described in claim 37, wherein the first remote communication device includes a second plurality of antenna elements.

47. A machine-readable medium as described in claim 46, wherein the first remote communication device includes a second smart antenna system that includes the second plurality of antenna elements.

48. A machine-readable medium as described in claim 37, wherein the communication station is coupled to an external data and/or voice network.

49. A machine-readable medium as described in claim 48, wherein the external network includes the Internet.

50. A machine-readable medium as described in claim 37, wherein the first remote communication device includes a first remote user terminal.

51. A machine-readable medium as described in claim 50, wherein the first remote user terminal is mobile.

52. A machine-readable medium as described in claim 40, wherein the steps of transmitting in the first and second non-directional manners include mitigating interference towards the undesired communication devices.

53. A machine-readable medium as described in claim 40,

wherein the first smart antenna processing strategy is for transmission in a first direction wherefrom there were no substantial signals received at the communication station in the receiving step,

wherein the second smart antenna processing strategy is for transmission in a second direction wherefrom there were no substantial signals received at the communication station in the receiving step, and

wherein the first and the second directions differ.

54. A machine-readable medium as described in claim 53, wherein the first and second smart antenna processing strategies are determined from the received signal covariance of the signals received at the communication station in the receiving step.

55. A method of paging a first remote communication device on the downlink from a first communication station of a communication system, the communication system including at least none or more other communication stations distinct from the first communication station, each associated with one or more other remote communication devices, the first communication station associated with at least a first remote communication device, and including a smart antenna system having an array of antenna elements, the method comprising:

providing a first set of sequential time intervals for the first communication station for communication with its associated remote communication devices, each time interval of the first set including a selected number of downlink conventional channels;

transmitting a first paging signal from the first communication station to the first remote communication device during a first downlink conventional channel of a first time interval of the first set; and

repeating the transmitting at a time interval later than the first time interval, the repeated transmitting being of a second paging signal from the first communication station to the first remote communication device on a downlink conventional channel of the first set,

the repeated transmitting step using a strategy other than identical repetition to facilitate the set of remote communication devices actively receiving on the downlink on the first downlink conventional channel during the first transmitting step differing from the set of remote communication devices actively receiving during the repeated transmitting step on the downlink conventional channel used for paging during the repeated transmitting step.

56. A method as describe in claim 55,

wherein each remote communication device of the first communication station has an active state wherein it is in active communication with its base station, and an idle state wherein it has established its identity but is not actively communicating, and

wherein the first remote communication device is in an idle state during the first transmitting step of the paging signal.

57. A method as describe in claim 55, further comprising:

the first remote communication device providing feedback to the first communication station indicating whether or not the first remote communication device has successfully received the first paging signal; and

the first communication station determining from the feedback whether or not the first paging signal was successfully received by the first remote communication device;

wherein the repeated transmitting step is carried out in the case that the first communication station determines that the first paging signal was not successfully receive by the first remote communication device.

58. A method as describe in claim 55, wherein the later time of the repeated transmitting step is the next time interval of the first set.

59. A method as describe in claim 55, wherein each of the selected number of downlink conventional channels within each time interval is a different downlink data transfer period within the time interval.

60. A method as describe in claim 55, wherein said repeated transmitting step occurs on a different downlink conventional channel than the first downlink traffic data transfer conventional channel of first transmitting step.

61. A method as describe in claim 59, wherein each downlink data transfer period within the time interval is divided into at least two sub-periods of time, and wherein the first transmitting step occurs in a first sub-period of the first downlink traffic data transfer period, and wherein the repeated transmitting step occurs in a different sub-period of the first downlink traffic data transfer period.

62. A method as describe in claim 59, wherein each downlink traffic data transfer period within the time interval is divided into at least two sub-periods of time, and wherein the first transmitting step occurs in a first sub-period of the first downlink traffic data transfer period, and wherein the repeated transmitting step occurs in a different sub-period of a different downlink traffic data transfer period.

63. A method as describe in claim 60, comprising carrying out transmitting step a number of times, the number of repetitions depending on an estimate of the proximity of the remote communication device, each repetition of transmitting step being on distinct downlink traffic data transfer conventional channels and different time intervals of the first set of sequential time intervals.

64. A method as describe in claim 55, further comprising:

determining a first downlink smart antenna processing strategy to transmit a downlink signal in a first non-directional manner; and

determining a second downlink smart antenna processing strategy to transmit a downlink signal in a second non-directional manner; and

wherein the first transmitting step uses the first downlink strategy to transmit in the first substantially non-directional manner,

wherein the repeated transmitting step uses the second downlink strategy to transmit in the second substantially non-directional manner, and

wherein the first substantially non-directional manner differs from the second substantially non-directional manner.

65. A method as describe in claim 64, further comprising

receiving one or more signals transmitted from one or more remote communication devices of the communication system on a first uplink conventional channel, the one or more remote communication devices being known to the first communication station to be undesired remote communication devices in that each might receive one or more signals on the first downlink channel during the transmitting of the downlink signal from the first communication station,

wherein the first and second downlink smart antenna processing strategies use the signals from the one or more undesired remote communication devices.

66. A method as described in claim65, wherein the transmitting steps in the first and second non-directional manners include mitigating interference towards the undesired remote communication devices on the first downlink conventional channel.

67. A method as described in claim65Mitigating,

wherein the first smart antenna processing strategy includes transmitting the downlink signal in a first direction wherefrom there were no substantial signals received on the uplink on the first uplink conventional channel,

wherein the second smart antenna processing strategy includes transmitting the downlink signal in a second direction wherefrom there were no substantial signals received on the uplink on the first uplink conventional channel, and

wherein the first and the second directions differ.

68. A method as described in claim67, wherein the first and second downlink smart antenna processing strategies are determined from the received signal covariance of the signals received on the first uplink conventional channel.